REMARKS

Summary of the Office Action

In the Office Action, claims 1-3, 5-8 and 12-14 stand rejected under 35 U.S.C. § 103 (a), as being unpatentable over U.S. Patent No. 4,976,582 to *Clavel* in view of U.S. Patent No. 2,733,085 to *Latzen*.

Summary of the Response to the Office Action

Applicant proposes amending claims 1 and 12, and adding new claims 15-20. Accordingly, claims 1-3, 5, 7, 8 and 12-16 are pending for further consideration (claims 4, 6 and 9-11 being canceled).

All Claims are Allowable

Claims 1-3, 5-8 and 12-14 stand rejected under 35 U.S.C. § 103 (a), as being unpatentable over U.S. Patent No. 4,976,582 to *Clavel* in view of U.S. Patent No. 2,733,085 to *Latzen*. Applicant traverses this rejection for the following reasons.

With regard to independent claim 1, Applicant respectfully asserts that *Clavel* and *Latzen*, viewed either singly or in combination, fail to teach or fairly suggest an industrial robot, "wherein a bearing element is fixed so that the bearing element does not rotate in a housing in the socket of a joint, the housing including a surface against which the bearing element abuts and the surface being provided with friction-increasing means in the form of grooves engageable with the bearing element to increase friction between the surface and the bearing element, the grooves in the housing surface being arranged parallel with a central axis of the housing, the grooves engaging the bearing element to deform the bearing element and thereby prevent rotation of the bearing element in the housing, the grooves facilitating installation of the bearing element in the housing, and the grooves further facilitating removal from and replacement of the bearing element within the housing," as recited in independent claim 1, as amended.

Support for these limitations recited in claim 1 can be found at least on pages 3 and 4 of the originally filed specification, and in Figs. 1-3 and 5 of the originally filed drawings. Specifically, as shown in Figs. 1-3, the present invention discloses an industrial robot including at least one linkage device in which pull rods are arranged in a multi-joint system where the joints include three-axle ball and socket joints. The ball and socket joints include a bearing element 3, which is fixed so as not to rotate in housing 2 of the socket joint. In order to increase the contact friction between surface 4 of housing 2 and bearing element 3, in one particular embodiment, bearing element 3 may be provided with friction-increasing means in the form of grooves 5' arranged substantially parallel with the central axis of the housing (see Figs. 3 and 4, page 3, lines 29-30 and page 4, lines 4-8). In the embodiment of bearing element 3 including grooves 5', these grooves on bearing element 3 may abut against surface 4 of housing 2, which also includes friction-increasing means in the form of complementary grooves engageable with the grooves provided on bearing element 3 to increase friction between surface 4 and bearing element 3 (see page 4, lines 4-8). Alternatively, if the bearing element 3 does not include grooves 5', surface 4 of housing 2 may nevertheless include friction-increasing means in the form of grooves engageable with bearing element 3 to increase friction between surface 4 and bearing element 3, (see embodiment of Figs. 1 and 2). The provision of the grooves on the surface of housing 2 prevents rotation of the bearing element in the housing since upon installation of the bearing element in the housing, the bearing element deforms to conform to the grooves in the housing. The grooves thus facilitate installation of the bearing element in the housing, and further facilitate removal from and replacement of the bearing element within the housing, as discussed in greater detail below.

The Office Action cites *Clavel* and *Latzen* as teaching or suggesting the invention recited in claims 1-3, 5-8 and 12-14.

Specifically, *Clavel* discloses a standard robot including ball and socket type joints. As acknowledged in the Office Action, *Clavel* does not disclose the ball and socket joints including a bearing and friction-increasing means.

Latzen, as illustrated in Fig. 1 thereof, discloses a conventional ball and socket joint including a bearing 7 having a circumferential knurled rim 15, (Col. 2: 10-13). As discussed in Col. 2:12-13 of *Latzen*, the provision of the knurled rim 15 on bearing 7 compensates for any eccentricity in the ball/socket connection, and ensures a good seat. As discussed in Col. 2:4-9, *Latzen* also indicates that "structural features of the ball and socket joint according to this invention are ball bearing means ... as well as different shaped grooves cut into the inner wall of the housing or the ball head 1." In the description following this statement, *Latzen* describes lubricating grooves 10 or 12 in ball head 1, but does not thereafter mention the "grooves cut into the inner wall of the housing," (see Col. 2: 10-39).

Contrary to the recitation in independent claim 1 of the present invention, Applicant respectfully asserts that *Latzen* does not teach or fairly suggest, "the housing including a surface against which the bearing element abuts and the surface being provided with friction-increasing means in the form of grooves engageable with the bearing element to increase friction between the surface and the bearing element, the grooves in the housing surface being arranged parallel with a central axis of the housing, the grooves engaging the bearing element to deform the bearing element and thereby prevent rotation of the bearing element in the housing, the grooves facilitating installation of the bearing element in the housing, and the grooves further facilitating removal from and replacement of the bearing element within the housing," as recited in independent claim 1, as amended.

Specifically, whereas bearing 7 of *Latzen* includes a circumferential knurled rim 15, for the present invention, surface 4 of housing 2 includes friction-increasing means in the form of grooves engageable with bearing element 3 to increase friction between surface 4 and bearing element 3. Thus *Latzen* does not teach or fairly suggest, "the housing including a surface against

which the bearing element abuts and the surface being provided with friction-increasing means in the form of grooves engageable with the bearing element to increase friction between the surface and the bearing element," as recited in independent claim 1, as amended.

Furthermore, whereas the bearing of *Latzen* is merely seated within housing 2, for the present invention, the bearing element actually deforms to conform to the grooves in the housing. Thus *Latzen* also does not teach or fairly suggest, "the grooves engaging the bearing element to deform the bearing element and thereby prevent rotation of the bearing element in the housing," as recited in independent claim 1, as amended.

Applicant respectfully asserts that the aforementioned distinctions between the present invention and the teachings of *Latzen* are significant, in that the provision of the grooves on the surface of housing 2 prevents rotation of the bearing element in the housing, since upon installation of the bearing element in the housing, the bearing element deforms to conform to the grooves in the housing. As also recited in independent claim 1, the grooves thus facilitate installation of the bearing element in the housing, and further facilitate removal from and replacement of the bearing element within the housing.

Applicant respectfully notes that whereas *Latzen* does indicate in Col. 2:4-9 that "structural features of the ball and socket joint according to this invention are ball bearing means ... as well as different shaped grooves cut into the inner wall of the housing or the ball head 1," these grooves mentioned by *Latzen* are merely lubricating grooves, such as grooves 10 or 12 in ball head 1. Thus based upon the teachings of Latzen, the "grooves cut into the inner wall of the housing" are only intended to be provided for lubrication purposes, and not for "engaging the bearing element to deform the bearing element and thereby prevent rotation of the bearing element in the housing," as recited in independent claim 1 of the present invention. Thus *Latzen* only teaches providing a knurled rim 15 for compensating any eccentricity (Col. 2: 10-13) and lubricating grooves, such as grooves 10 or 12 in ball head 1, and does not teach any "knurls" or

"grooves" in the context of the present invention for engaging the bearing element, and thereby deforming the bearing element.

Applicant further respectfully notes that for the present invention, the provision of the grooves on the surface of the housing is not a mere inversion of the knurled rim 15 on bearing 7 of *Latzen* with knurls being provided on a surface of housing 2 of *Latzen*, since the grooves provided on the surface of housing 2 for the present invention are designed to serve the multiple functions of preventing rotation of the bearing element in the housing, deforming the bearing element upon installation, facilitating installation of the bearing element in the housing, and further facilitating removal from and replacement of the bearing element within the housing. For the present invention, installation, removal and replacement of the bearing element is enabled by simply pulling the bearing element in the direction of the central axis of the grooves in the housing surface (for removal), and attaching a new bearing element by pushing the bearing element in a direction opposite to the removal direction (for installation and replacement).

These noted benefits of providing grooves on the surface of housing 2 for the present invention are important because the present invention is directed to an industrial robot, such as a Delta Robot, which has extremely rapid movements back and forth on the order of 0.5 seconds/stroke resulting in wear and requiring frequent replacement of the bearing element to prevent damage to the robot joints, (see description page 2, lines 14-16). In such industrial robots, a bearing 7 including knurled rims 15, as disclosed by *Latzen*, could not be adequately and economically used, since the bearing of *Latzen* would damage the housing of such a robot joint due to the knurled rims 15. During subsequent replacement of the bearing, the damaged housing would further lose its bearing retention capabilities due to damage by the knurled rims. Thus the bearing of *Latzen* could not be used with industrial robots, which is what the ball/socket joint according to the present invention is directed to.

Applicant further respectfully notes that the present invention has been realized by the inventors due to the need for frequent replacement of the bearing element to prevent damage to

the robot joints, and thus, as recited in independent claim 1, the invention recites an industrial robot joint for which, "the housing including a surface against which the bearing element abuts and the surface being provided with friction-increasing means in the form of grooves engageable with the bearing element to increase friction between the surface and the bearing element, the grooves in the housing surface being arranged parallel with a central axis of the housing, the grooves engaging the bearing element to deform the bearing element."

Applicant respectfully asserts that based at least upon the aforementioned distinctions, *Clavel* and *Latzen* clearly do not teach or suggest an industrial robot, "wherein a bearing element is fixed so that the bearing element does not rotate in a housing in the socket of a joint, the housing including a surface against which the bearing element abuts and the surface being provided with friction-increasing means in the form of grooves engageable with the bearing element to increase friction between the surface and the bearing element, the grooves in the housing surface being arranged parallel with a central axis of the housing, the grooves engaging the bearing element to deform the bearing element and thereby prevent rotation of the bearing element in the housing, the grooves facilitating installation of the bearing element in the housing, and the grooves further facilitating removal from and replacement of the bearing element within the housing," as recited in independent claim 1, as amended.

As pointed out in M.P.E.P. § 2143.03, "[t]o establish prima facie obviousness of a claimed invention, all the claimed limitations must be taught or suggested by the prior art". *In re Royka*, 409 F.2d 981, 180 USPQ 580 (CCPA 1974). Since this criterion has not been met, Applicant respectfully asserts that the rejection under 35 U.S.C. § 103 (a) should be withdrawn because *Clavel* and *Latzen* do not teach or suggest each feature of independent claim 1.

In view of the above arguments, Applicant respectfully requests the rejection of independent claim 1 under 35 U.S.C. § 103 be withdrawn. Moreover, claims 2, 3, 5, 7, 8 and 15, which depend from independent claim 1, are allowable at least because their base claim is allowable, as well as for the additional features recited therein.

Independent claim 12

With regard to independent claim 12, Applicant respectfully asserts that *Clavel* and *Latzen* do not teach or fairly suggest a method for eliminating risk of play in a three-axle ball and socket joint in an industrial robot, "comprising the steps of providing at least one linkage device for the robot, the device having pull rods arranged in a multi-joint system where the joints each comprise the three-axle ball and socket joint, providing a socket of the joint with a housing to accommodate a bearing element, providing the housing with a surface against which the bearing element abuts, fixing the bearing element such that the bearing element does not rotate in the housing, the fixing step being effected by providing the surface with friction-increasing means in the form of grooves engageable with the bearing element, and engaging the friction-increasing means with the bearing element when the bearing element is positioned in place, the grooves in the housing surface being arranged parallel with a central axis of the housing, the grooves engaging the bearing element to deform the bearing element and thereby prevent rotation of the bearing element in the housing, the grooves facilitating installation of the bearing element in the housing, and the grooves further facilitating removal from and replacement of the bearing element within the housing," as recited in claim 12, as amended.

Applicant respectfully asserts that claim 12 is allowable at least for the reasons presented above for the allowance of claim 1, and the additional features recited therein. In the interest of avoiding redundant arguments, reasons for the allowance of claim 12 are not repeated herein. In view of the above arguments, Applicant respectfully requests the rejection of independent claim 12 under 35 U.S.C. § 103 be withdrawn. Moreover, claims 13, 14 and 16, which depend from independent claim 12, are allowable at least because their base claim is allowable, as well as for the additional features recited therein.

New claims 15 and 16

With regard to new dependent claim 15 (and likewise claim 16), Applicant respectfully asserts that *Clavel* and *Latzen* do not teach or fairly suggest "wherein the bearing element further includes friction-increasing means in the form of grooves arranged parallel with a central axis of the bearing element, the grooves on the surface of said housing being engageable with the grooves provided on the bearing element to increase friction between the surface and the bearing element," as recited in dependent claim 15.

Specifically, as noted above, *Clavel* discloses a standard robot including ball and socket type joints. As acknowledged in the Office Action, *Clavel* does not disclose the ball and socket joints including a bearing and friction-increasing means.

Latzen, as illustrated in Fig. 1 thereof, discloses a conventional ball and socket joint including a bearing 7 having a circumferential knurled rim 15, (Col. 2: 10-13). As discussed in Col. 2:12-13, the provision of the knurled rim 15 on bearing 7 compensates for any eccentricity in the ball/socket connection, and ensures a good seat. As discussed in Col. 2:4-9, *Latzen* also indicates that "structural features of the ball and socket joint according to this invention are ball bearing means ... as well as different shaped grooves cut into the inner wall of the housing or the ball head 1." In the description following this statement, *Latzen* describes lubricating grooves 10 or 12 in ball head 1, but does not thereafter mention the "grooves cut into the inner wall of the housing," (see Col. 2: 10-39).

With regard to dependent claim 15 (and likewise claim 16), Applicant respectfully asserts that contrary to the teachings of *Latzen* for which bearing 7 includes a knurled rim 15, for the present invention, the surface of housing 2 includes friction-increasing means in the form of complementary grooves engageable with the grooves provided on the bearing element to increase friction between the surface and the bearing element. As noted above, the provision of the grooves on the surface of housing 2, and further the provision of the complementary engagement of these grooves with grooves on the surface of the bearing element facilitates

installation of the bearing element in the housing, and further facilitates removal from and replacement of the bearing element within the housing by simply pulling the bearing element in the direction of the central axis of the grooves in the housing surface, and attaching a new bearing element by pushing the element in a direction opposite to the removal direction.

Applicant again emphasizes that whereas *Latzen* does indicate in Col. 2:4-9 that "structural features of the ball and socket joint according to this invention are ball bearing means ... as well as different shaped grooves cut into the inner wall of the housing or the ball head 1," these grooves mentioned by *Latzen* are merely lubricating grooves, such as grooves 10 or 12 in ball head 1. Thus based upon the teachings of Latzen, the "grooves cut into the inner wall of the housing" are only intended to be provided for lubrication purposes, and are not "engageable with the grooves provided on the bearing element to increase friction between the surface and the bearing element," as recited in independent claim 15 of the present invention. Thus *Latzen* only teaches providing a knurled rim 15 for compensating any eccentricity (Col. 2: 10-13) and lubricating grooves, such as grooves 10 or 12 in ball head 1, and does not teach any "knurls" or "grooves" in the context of the present invention for engaging the grooves on the bearing element.

Applicant respectfully asserts that based at least upon the aforementioned distinctions, *Clavel* and *Latzen* clearly do not teach or fairly suggest "wherein the bearing element further includes friction-increasing means in the form of grooves arranged parallel with a central axis of the bearing element, the grooves on the surface of said housing being engageable with the grooves provided on the bearing element to increase friction between the surface and the bearing element," as recited in dependent claim 15.

New independent claim 17

With regard to new independent claim 17, Applicant respectfully asserts that *Clavel* and *Latzen* do not teach or fairly suggest an industrial robot including, "at least one linkage device in

which pull rods are arranged in a multi-joint system where the joints include three-axle ball and socket joints, wherein a bearing element is fixed so that the bearing element does not rotate in a housing in the socket of a joint, the housing including a surface against which the bearing element abuts and the surface being provided with friction-increasing means engageable with the bearing element to increase friction between the surface and the bearing element, the friction-increasing means being configured to facilitate installation of the bearing element in the housing, the socket being shaped as one-half of a sphere or less so as to facilitate rapid pivotal movement of the linkage relative to the socket, the one-half of a sphere shape of the socket further facilitating removal from and replacement of the bearing element within the housing by enabling rapid disconnection of said ball and socket joint," as recited in new independent claim 17.

Support for these limitations recited in claim 17 can be found at least on pages 3 and 4 of the originally filed specification, and in Figs. 1-3 and 5 of the originally filed drawings. Specifically, as shown in Figs. 1-3, the present invention discloses an industrial robot including at least one linkage device in which pull rods are arranged in a multi-joint system where the joints include three-axle ball and socket joints. The ball and socket joints include a bearing element 3, which is fixed so as not to rotate in housing 2 of the socket joint. In order to increase the contact friction between surface 4 of housing 2 and bearing element 3, in one particular embodiment, bearing element 3 is provided with friction-increasing means (see Figs. 3 and 4, page 3, lines 29-30 and page 4, lines 4-8). The provision of the friction-increasing means on the surface of housing 2 prevents rotation of the bearing element in the housing since upon installation of the bearing element in the housing, the bearing element deforms to conform to the friction-increasing means in the housing. The friction-increasing means thus facilitate installation of the bearing element in the housing, and further facilitate removal from and replacement of the bearing element within the housing, as discussed in greater detail below.

Additionally, as illustrated in Figs. 1-4 and discussed on page 3, lines 14-17 of the original specification, socket 1 is shaped as one-half of a sphere or less so as to facilitate rapid

pivotal movement of the robot linkage relative to the socket. Due to the "one-half of a sphere" shape of the socket, the ball and socket assembly for the industrial robot of the present invention is required to be held together by the provision of a spring biased connection. The spring biased connection thus facilitates removal and replacement of the bearing element from the housing by a simple removal of the spring force and disconnection of the ball and socket joint.

As noted above, *Clavel* discloses a standard robot including ball and socket type joints. *Clavel* however does not disclose the ball and socket joints including a bearing, friction-increasing means or a socket having a "one-half of a sphere" shape.

Latzen, as illustrated in Fig. 1 thereof, discloses a conventional ball and socket joint including a bearing 7 having a circumferential knurled rim 15, (Col. 2: 10-13). As discussed in Col. 2:12-13, the provision of the knurled rim 15 on bearing 7 compensates for any eccentricity in the ball/socket connection, and ensures a good seat. Additionally, as illustrated in Figs. 1-4 of *Latzen*, the socket has a generally cylindrical shape.

Contrary to the teachings of *Clavel* and *Latzen*, as recited in independent claim 17, illustrated in Figs. 1-4 and discussed on page 3, lines 14-17 of the original specification, socket 1 is shaped as one-half of a sphere or less so as to facilitate rapid pivotal movement of the robot linkage relative to the socket. The provision of the "one-half of a sphere" shape is important for joint 1 because the socket/joint assembly of the present invention is directed to an industrial robot, such as a Delta Robot, which has extremely rapid movements back and forth on the order of 0.5 seconds/stroke resulting in wear and requiring frequent replacement of the bearing element to prevent damage to the robot joints, (see description page 2, lines 14-16). In such industrial robots, the cylindrical joint disclosed by *Latzen* could not be adequately used since such a joint would prevent rapid movement of the robot links.

Furthermore, as noted above, due to the "one-half of a sphere" shape of the socket, the ball and socket assembly for the industrial robot of the present invention is held together by the provision of a spring biased connection. Thus without the spring biased connection, the

ball/socket assembly would become disassembled. Based precisely on this feature, the spring biased connection thus facilitates removal and replacement of the bearing element from the housing by a simple removal of the spring force and disconnection of the ball and socket joint.

Applicant respectfully notes that the ball/socket assembly of *Latzen* provides none of the linkage assembly, disassembly or movement benefits listed above, and further provides none of the benefits of allowing a bearing element to be rapidly removed and replaced, as is virtually a constant necessity with such industrial robots.

Based at least upon the aforementioned distinctions, Applicant respectfully asserts that *Clavel* and *Latzen* clearly do not teach or fairly suggest "the friction-increasing means being configured to facilitate installation of the bearing element in the housing, the socket being shaped as one-half of a sphere or less so as to facilitate rapid pivotal movement of the linkage relative to the socket, the one-half of a sphere shape of the socket further facilitating removal from and replacement of the bearing element within the housing by enabling rapid disconnection of said ball and socket joint," as recited in independent claim 17.

Moreover, claims 18-20, which depend from independent claim 17, are allowable at least because their base claim is allowable, as well as for the additional features recited therein.

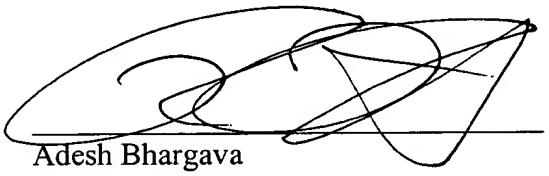
CONCLUSION

In view of the foregoing, Applicant respectfully requests reconsideration and the timely allowance of the pending claims. Should the Examiner feel that there are any issues outstanding after consideration of the response, the Examiner is invited to contact the Applicant's undersigned representative to expedite prosecution.

If there are any other fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 04-2223. If a fee is required for an extension of time under 37 C.F.R. §1.136 not accounted for above, such an extension is requested and the fee should also be charged to our Deposit Account.

Respectfully submitted,

DYKEMA GOSSETT PLLC

Dated: September 7, 2004 By: 

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